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Interval methods for the identification and quantification of inhomogeneous uncertainty in high-dimensional models: a tutorial

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The quantification of inhomogeneous uncertain parameters in Finite Element models is a challenging task in case no direct measurement of these quantities is possible and when the available data are very scarce. In that case, classical probabilistic approaches such as Bayes' method might give unsatisfactory results due to necessary subjective assumptions on prior density and likelihood functions. The authors recently introduced interval methods to cope with this situation by introducing an inverse approach to quantify interval field uncertain parameters, based on a limited set of indirect measurement data. These methods are based on the representation of the uncertainty in the responses of the structure as a convex set, and minimising the discrepancy between the convex set of the model responses and the convex set of replicated measurement data. The method is the first that is able to quantify an interval field on parameters that cannot be measured directly. This paper gives a brief overview of the recent developments in the inverse quantification of spatial interval uncertainty and aims at giving a tutorial for the practical application of these new inverse methods. A general outline of the method is presented, and a small scale illustration of the method is included to show the application.